

## APPENDIX A

### GLOSSARY

**Accuracy** - degree to which the value obtained in an assay corresponds to the "true" value.

**Adjuvant** - a substance, usually injected with an antigen, which improves the immune response to the antigen.

**Affinity** - The strength of the binding between binding reagent and a ligand.

**Analog** - a member of a family of molecules whose major structural characteristics are identical, with only minor structural differences.

**Analyte** - a compound or family of compounds in a sample to be analyzed in an assay.

**Antibody (Ab)** - an immunoglobulin produced in an animal in response to an antigen (or hapten combined with its macromolecular carrier) which can react specifically to form an antigen-antibody complex.

**Antibody-Binding Site** - Sites on the antibody that react with the determinant sites on antigens.

**Antigen (Ag)** - a substance which can elicit the formation of antibodies and react specifically with the antibodies formed.

**Antisera** - antibody containing sera.

**Avidity** - the strength of the bond between a binding reagent (antibody) and a ligand (antigen or hapten).

**Bound** - antigen which is present as a complex, attached to antibody; that fraction of the reaction mixture of an immunoassay which contains the antigen-antibody complex.

**Carrier** - An immunogenic substance that, when coupled to a hapten, renders the hapten immunogenic.

**Chromogen Substrate** - a substrate which produces a color when it reacts with its specific enzyme, the intensity of the color produced being directly proportional to the amount of enzyme available to react with the chromogen substrate.

**Competitive Assay** - an immunoassay based on the principle of competition between the test (unknown) antigen and antigen labeled with an isotope or an enzyme for a limited number of antibody binding sites.

**Competitive Immunoassay** - an immunoassay method involving an in-vitro competitive binding reaction.

**Conjugates** - enzymes linked to antigens or antibodies in such a manner that each retains the maximum amount of their reactivity.

**Control** - a sample-like preparation containing a known amount of analyte or devoid of analyte that is treated in the assay as an unknown sample.

**Cross-reaction** - reaction of an antibody with more than one antigenic structure.

**Determinant** - unique small three-dimensional surface sites on antigen molecules that react (combine) with antibody-binding on antibodies.

**ELISA (Enzyme-Linked Immunosorbent Assay)** - a heterogeneous immunoassay utilizing enzyme-labeled antigens or antibodies.

**Enzyme** - a protein capable of catalyzing a reaction of a substrate molecule to form a product. Enzymes can be highly specific for a given substrate.

**Enzyme Conjugate** - a molecule produced by the coupling of an enzyme molecule to an immunoassay component that is responsible for acting upon a substrate to produce a detectable signal.

**Enzyme Immunoassay (EIA)** - an immunoassay utilizing enzyme labeled antigens, antibodies, or haptens. There are two main types of EIA procedures; homogeneous assays and heterogenous (ELISA) assays.

**False Negatives** - a negative interpretation of the method containing the target analytes at or above the detection level. Ideally, an immunoassay test product included in an SW-846 method should produce no false negatives. The maximum permissible false negative rate is 5%, as measured by analyzing split samples using both the test product and a reference method.

**False Positives** - a positive interpretation for a sample is defined as a positive response for a sample that contains analytes below the action level.

**Free** - antigen which is not attached to antibody; that fraction of the reaction mixture in an immunoassay which contains the free antigen.

**Hapten** - a small molecule which is not antigenic in itself but when attached to a large molecule (macromolecular carrier) can stimulate the formation of antibodies. A hapten, like an antigen, can react with its specific antibodies once they have been produced.

**Hapten-Carrier Conjugate** - The coupling of a non-immunogenic molecule (e.g., targeted analyte) to an immunogenic substance (e.g., bovine serum albumin, keyhole limpet hemocyanin) for the purpose of stimulating an immune response.

**Heterogeneous Immunoassay** - a type of immunoassay that requires a separation of bound and free phases. Generally, accompanied by incubation and washing steps (ELISA Assays).

**Homogeneous Immunoassay** - a type of immunoassay that does not require washing steps i.e. it requires no physical separation between the bound and free phases.

**Immunoassay** - an analytical technique that uses an antibody molecule as a binding agent in the detection and quantitation of substances in a sample. (see Enzyme Immunoassay and ELISA)

**Immunogen** - a synonym for antigen, particularly when used to describe a substance used to elicit an immunologic response in an animal.

**Immunity** - a state, natural or acquired, in which the body is resistant to disease.

**Immunoglobulin** - the class of globular proteins (gamma globulins) which are antibodies. There are five classes of immunoglobulin (IgM, IgA, IgD, IgG and IgE).

**Immunology** - the science that deals with study of immunity to diseases.

**Ligand** - a member of a binding pair, generally the smaller member. For example, in an enzyme-substrate reaction the substrate is frequently referred to as a ligand. The antigen or hapten may be called a ligand in an antibody reaction.

**Lymphocytes** - One of the five classes of white blood cells found in the circulatory system of vertebrates.

**Monoclonal Antibodies** - a homogeneous preparation of antibodies directed at a single antigenic determinant produced from a single clone of an antibody producing lymphocyte hybridized with a "tumor" cell line to form a hybridoma which continuously secretes a single antibody molecule.

**Polyclonal Antibodies** - a group of antibody molecules that differ in amino acid composition and sequences, and that exhibit binding characteristics. Polyclonal antibodies are produced from a simulation of multiple clones of lymphocytes.

**Polyclonal antiserum** - an antibody containing serum which is made up of antibodies from more than one clone of lymphocyte. Usually produced in vivo by immunizing animals with an antigen.

**Precision** - extent to which the obtained measurements of a defined substance agree with one another, usually stated as coefficients of variation, relative standard deviations, or confidence limits.

**Quality Control** - a planned system of activities whose purpose is to provide a quality product.

**Radioimmunoassay (RIA)** - an immunologic test utilizing a radiolabeled antigen, antibody, or other reactants.

**Replicates** - repeated but independent determinations on the same sample by the same analyst at essentially the same time under the same conditions.

**Sandwich Assay** - an immunoassay technique for measuring antigen in a test sample that "sandwiches" the antigen being measured between two antibodies.

**Sensitivity** - sensitivity of a laboratory procedure refers to the ability of the test to detect or respond to small changes in concentration; the more sensitive the test, the more likely it will detect minute quantities.

**Serology** - generally considered a subdivision of immunology, it is the study of blood serum reactions such as antigen-antibody interactions and complement.

**Solid Phase** - separation method in which the binding reagent is immobilized by coupling to an insoluble material (magnetic particles, coated tubes, polymers, etc.).

**Specificity** - the characteristic of a laboratory test that distinguishes between true (specific) and inaccurate (non-specific) results. Non-specific reactions may be caused by cross-reactions or interferences from matrix factors.

**Standard Curve** - the dose-response curve generated in a quantitative immunoassay by running a series of reference standards containing known concentrations of analyte. It is used to calculate the concentration of unknown samples from their response data.

**Standard Deviation** - often the measure of precision. Mathematically defined as the square root of the sum of the squares of the difference between the individual values of a set and the arithmetic mean of the set, divided by one less than the number of values.

**Stopping Reaction** - stopping reaction refers to the addition of a solution to prevent further increases of color from occurring due to conversion of a chromogenic substrate. For example, the end result in ELISA assays is the intensity of color produced over a given period of time from conversion of a substrate caused by reaction with an enzyme conjugate. The stopping solution is used to prevent further increases in intensity of color after the given period of time.

**Substrate** - substances chosen to react with enzymes that provide a sensitive method for detection of the antigen or antibody being measured. Generally, chromogenic substrates are chosen which are colorless initially, but which form colored products as they are converted by the enzyme reaction.

**Titer** - the greatest dilution of a substance used in a serologic reaction that will produce the desired result.

## APPENDIX B

### TECHNICAL IMMUNOASSAY DESCRIPTION

Immunoassays are divided into two distinct classes that are referred to as heterogeneous and homogeneous. The present state-of-the-art in environmental IA analyses use a heterogeneous assay where an antigen/antibody complex, containing the Compound of Interest, is bound to a solid substrate and a separation step is required to remove excess free sample and reagents. Homogeneous assays do not require separation of the bound and free substances and the antibody can directly modulate the signal produced.

IA can rely on a single antibody (monoclonal) or mixtures of antibodies (polyclonal) to trap or collect the antigen(s), otherwise known as the Compound Of Interest (COI). Most environmental IA analyses rely on monoclonal antibodies. Antibodies are a class of proteins known as immunoglobulins which are produced in animals in response to a foreign substance (antigen). The small molecular weight antigen (COI) may not cause an immune response in the animal, so it must be coupled to a "carrier" molecule which will present the small molecule (haptan) to the immune system as a foreign substance. The antibody is capable of reacting specifically with the antigen to form an antigen/antibody complex (commonly referred to as the lock and key approach).

In immunochemical methods, the unreacted antigen and antibody are referred to as the free phase, while the antigen/antibody complex is referred to as the bound phase. This highly sensitive three dimensional stereo-chemical reaction between antigens and antibodies is the basis for immunoassay technology.

Because individual chemical compounds of low molecular weight have specific three dimensional stereo-chemical structures (molecular geometries), there are few other compounds of exact or similar three dimensional structures that will react with the antibody. Compounds having similar three dimensional stereo-chemical structures that react with the antibody are said to be cross-reactive.

The development of an appropriate antibody that will bind to an antigen (COI) or a COI attached to an enzyme (otherwise known as an "enzyme conjugate") is the most important phase of designing an immunochemical specific test kit. Monoclonal antibodies are produced by a single cell and generally have a high degree of specificity and low cross-reactivity. This makes them ideal for designing IA kits that are specific for one compound. Polyclonal antibodies contain a mixture of antibodies that detect a range of compounds having similar structures. Because they are less specific, polyclonal antibodies are better suited to the detection of classes of compounds and they are rarely used in environmental analyses.

Enzyme Linked Immunosorbant Assay (ELISA) is an enzyme immunoassay method that uses an immobilized antibody absorbed onto a plastic well, tube, polymer particle, or magnetic particle to facilitate the separation of the targeted analytes from the untargeted substances (free reaction components) using a washing step and an enzyme conjugate to generate the signal. The enzyme conjugate is the COI bound to an enzyme such as horseradish peroxidase. The signal, or reporter system, is a colorimetric determination of the chromogenic (color) response used for the interpretation or quantitation of results. Chromogenic responses are analyzed photometrically, and use the principles of Beer's Law to determine the concentration of analyte in a sample.

ELISA tests are competitive assays utilizing immobilized antibodies that bind to pure contaminants (COIs), enzyme conjugates, or sometimes both in proportion to the relative concentration of the sample. The greater the concentration of the sample-derived COI relative to the enzyme conjugate, the larger the proportion of antibody sites that are occupied by the COI molecules. The antibody in most IA tests cannot bind to both at the same time. The bound

antibody/COI/enzyme conjugate is then washed to remove sample solution and excess reagents leaving the bound COI and enzyme conjugate antibody complex. A chromogen (for example, hydrogen peroxide and tetramethylbenzidine or hydrogen peroxide and orthophenylenediamine) is added to produce a color when it reacts in the presence of the IA specific enzyme conjugate. Specifically, the horseradish peroxidase reacts with the hydrogen peroxide to release a proton, which in turn reduces the tetramethylbenzidine to form the colored product. The amount of response (color) in solution is directly proportional to the amount of enzyme conjugate available to catalyze the reaction of the chromogen and hydrogen peroxide. The presence of the enzyme conjugate bound to the antibody is proportional to the amount of color formed. The chromogen/hydrogen peroxide (sometimes called a substrate) only reacts in the presence of the enzyme conjugate and does not react in the presence of the COI. This process results in a color formation in solution that is inversely proportional to the amount of chemical contaminant. More color equals less contaminant. Less color equals more contaminant. In the presence of high concentrations of contaminants, all the antibody sites are taken up by the chemical contaminant, thus, no color is developed because there is no enzyme conjugate present to catalyze the chromogen color reaction.

APPENDIX C

IMMUNOASSAY TABLES

Table values are reported from vendor literature. For consistency, the following general guidelines were used: values  $< 1.0$  are reported to two decimal places, if appropriate; values  $\geq 1.0$  are reported to two significant figures.

Table 1a - Vendor's Matrix

Parameter/Analyte	D-Tech		EN SYS		Ohmicron		Quantix/Idetek		BioNebraska		Hach	
	Water	Soil	Water	Soil	Water	Soil	Water	Soil	Water	Soil	Water	Soil
TPH			x	x	x	x	x	x			x	x
BTEX	x	x	x	x	x	x	x	x				
Benzene			x								x	
PAH	x	x	x	x	x	x		x				
C-PAH					x	x						
PCB		x		x	x	x						x
PCB (Wipe)		x		x		x						
PCB (Oils)				x								
TNT	x	x		x	x	x						
RDX	x	x	x	x								
Dioxin (2,3,7,8-TCDD)				x								
Mercury (Hg)			x	x					x	x		
Trihalomethanes (THMs)			x									
Pentachlorophenol (PCP)	x	x	x	x	x	x						
Trichloroethylene (TCE)	x	x										



Table 1b - Vendor's Pesticide, Insecticide and Herbicide Matrix

Parameter/Analyte	ENSYS		Ohmicron		Quantix/Idetek	
	Water	Soil	Water	Soil	Water	Soil
2,4-D	x, p	x	x	x		
Acetanilide	p					
Alachlor	x, p		x		x	
Aldicarb	x, p		x			
Atrazine	x, p		x		x	
Benomyl	x, p		x	x	x	x
Bioresmethrin	p					
Captan			x	x		
Carbaryl			x	x		
Carbofuran	x, p		x	x		
Chlordane		x				
Chlorothalonil			x		x	x
Chlorpyrifos	p		x			
Chlorpyrifos-methyl	x (g)		x			
Chlorsulfuron	p					
Cyanazine	x, p		x			
Cyclodienes	x, p		x			
DDT		x				
Diazinon	p					
Endosulfan	p					
Fenitrothion	x, p					
Hexazinone	p					
Imazaquin					x	
Imazapyr	p					
Isoproturon	p					
Lindane		x				
Metsulfuron	p					
Metalaxyl	p					
Methomyl			x			
Methoprene	x, p					
Metolachlor	x, p		x		x	
Metribuzin			x			
Molinate	p					
Nicotine	p (t)					
Paraquat	p		x			
Parathion	p					
Pirimiphos-methyl	x, p					
Procymidone	x		x			
Silvex	x	x				
Thiabendazole			x			
Toxaphene		x				
Triasulfuron	p					
Triazine	x, p					
Trichloropyridinol			x			
Triclopyr	p					
Urea Herbicides	p				x	

x = tube kit

(g) = for analysis in grain only

p = plate kit

(t) = for analysis in tobacco only

Table 2a - TPH/BTEX Reactivity

Parameter /Analyte	D-Tech		ENSYS		Ohmicron		Quantix/Idetek	
	Water ppm*	Soil ppm*	Water ppm*	Soil ppm*	Water ppm	Soil ppm	Water ppm	Soil ppm
<b>TPH</b>								
Gasoline	--	--	0.16	10	0.43	4.3	6.0	60
Diesel	--	--	0.24	15	1.3	13	1.0	25
Jet A Fuel	--	--	0.28	15	2.7	27	10	100
JP-4	--	--	0.18	15	0.5	20	1.0	25
Kerosene	--	--	0.22	15	1.5	15	5.0	50
Fuel oil #2	--	--	0.21	15	0.4	13	1.0	25
Fuel oil #6	--	--	--	25	0.2	13	--	--
Mineral Spirits	--	--	0.49	40	1.1	11	NR	NR
<b>BTEX</b>								
Benzene	1.2	5.0	5.0	400	0.59	5.9	3.9	49
Toluene	0.6	2.5	0.74	40	0.44	4.4	0.6	4.9
Ethylbenzene	0.6	2.5	0.06	7.0	0.24	2.4	0.7	4.9
o-Xylene	0.6	2.5	0.10	8.5	0.22	2.2	8.0	31
m-Xylene	1.4	5.8	0.10	8.0	0.03	0.3	5.0	18
p-Xylene	1.3	5.4	0.59	45	0.13	1.3	0.6	1.7
Total BTEX	0.6	2.5	0.20	10	0.02	0.2	0.25	3.5
Benzene (only)	NA	NA	0.005 #	NA	NA	NA	NA	NA

\* Lowest concentration that yields a positive test result

-- = not tested

# = test can give presence/absence indication at two detection levels (0.005 and 0.05 ppm)

NR = Not Responsive

NA = Not Available

Table 2b - PAH and C-PAH Reactivity

Parameter/Analyte	(rings)	D-Tech		ENSYS		Ohmicron		Ohmicron C-PAH		Quantix/Idetek	
		Water	Soil	Water	Soil	Water	Soil	Water	Soil	Water	Soil
		ppb*	ppm	ppb	ppm	ppb	ppm	ppb	ppm	ppb	ppm**
Acenaphthene	(3)	310	--	--	8.1	13	1.0	1100	>100	600	6.0
Acenaphthylene	(3)	310	--	--	7.5	10	1.3	150	22	20	0.2
Anthracene	(3)	10	--	--	0.81	0.54	0.05	0.44	0.58	--	>50
Benzo[a]anthracene	(4)	42	--	--	1.6	0.77	0.08	0.02	0.002	--	>50
Benzo[a]pyrene	(5)	10	--	--	8.3	0.50	0.05	0.08	0.01	--	>50
Benzo[b]fluoranthene	(5)	53	--	--	4.6	0.91	0.09	0.04	0.005	--	>50
Benzo[g,h,i]perylene	(6)	42	--	--	>200	15	1.5	0.30	0.12	--	>10
Benzo[k]fluoranthene	(5)	--	--	--	9.4	0.77	0.08	0.02	0.003	--	>50
Chrysene	(4)	8	--	--	1.2	0.40	0.04	0.04	0.005	--	>50
Dibenzo[a,h]anthracene	(5)	1100	--	--	>200	26	2.6	0.14	0.015	--	>50
Fluoranthene	(4)	5	--	--	1.4	0.32	0.03	2.0	0.22	--	0.40
Fluorene	(3)	110	--	--	1.5	1.6	0.16	37	3.5	200	1.6
Indeno[1,2,3-cd]pyrene	(6)	8	--	--	11	0.78	0.08	0.02	0.008	--	>10
Naphthalene	(2)	1800	--	--	200	65	6.5	380	36	100	1.2
Phenanthrene	(3)	420	--	--	1.0	0.70	0.07	2.7	0.43	30	0.3
Pyrene	(4)	10	--	--	3.5	0.20	0.02	2.0	0.09	400	4.0
Total PAH		8	0.6	--	--	--	--	--	--	50	0.7

\* Sensitivity is defined by lowest concentration of compound that yields a positive detection.

\*\* Lower Limit of Detection (LLD)

-- = not tested

Table 2c - PCB Reactivity

Parameter/Analyte	D-Tech			ENSYS			Ohmicron		
	Wipe *		Soil ppm	Wipe ug/100cm <sup>2</sup>	Oil/Liq. ppm	Soil ppm	Wipe ug/100cm <sup>2</sup>	Water ppm	Soil ppm
	Surf A	Surf B							
Aroclor 1016	100	51	5.7	40	9	4	36	0.94	2.7
Aroclor 1221	450	220	25	500	75	50	--	14	27
Aroclor 1232	160	82	9.0	40	10	4	26	0.84	2.2
Aroclor 1242	27	14	1.5	20	3.5	2	12	0.34	0.80
Aroclor 1248	14	7.2	0.8	10	2.5	1	8	0.22	0.42
Aroclor 1254	9.0	4.5	0.5	5	1	0.5	5	0.20	0.50
Aroclor 1260	9.0	4.5	0.5	5	1	0.5	3	0.20	0.30
Aroclor 1262	9.0	4.5	0.5	--	1	--	6	0.36	0.64
Aroclor 1268	69	34	3.8	--	9	--	31	0.92	2.3

\* wipe concentration = ug/100cm<sup>2</sup>

Surface A is used to interpret test results from non-porous surfaces such as smooth metal or glazed tile-like surfaces.

Surface B is used to interpret test results from painted surfaces, rusted metals, or concrete-like surfaces.

-- = not tested

Table 2d - TNT/RDX Explosives Reactivity

Parameter/Analyte	D-Tech		ENSYS		Ohmicron	
	Water	Soil	Water	Soil	Water	Soil
	ppb	ppm	ppm	ppm	ppb	ppm
TNT	5	0.5	--	0.7	0.07	0.25
RDX	5	0.5	--	0.8	--	--

TNT = Trinitrotoluene

RDX = Hexahydro-1,3,5-trinitro-1,3,5-triazine

-- = not tested

Table 2e - Individual Analyte Reactivity

Parameter/Analyte	D-Tech		ENSYS		Ohmicron		BioNebraska	
	Water	Soil	Water	Soil	Water	Soil	Water	Soil
	ppm	ppm	ppb	ppm	ppb	ppm	ppb	ppm
Mercury	--	--	250**	0.5**	--	--	250	0.5
Pentachlorophenol	(1)	(1)	5	0.5	0.06	0.1	--	--
Trichloroethylene (TCE)	1.5	5	--	--	--	--	--	--
Tetrachloroethylene (PCE)	0.3	1	--	--	--	--	--	--
Dioxin (2,3,7,8-TCDD)	--	--	0.4	(2)	--	--	--	--
Benzene (see also BTEX)	--	--	5	--	--	--	--	--

\*\* ENSYS Markets the BioNebraska kits

(1) Kit scheduled for release, sensitivity unknown.

(2) Laboratory analysis only. MDL equal to parts per trillion (ng/L) or parts per quadrillion (pg/L) depending on sample concentration factor.

-- = not tested

Table 2f - Individual Pesticide, Insecticide, and Herbicide Reactivity						
Parameter/Analyte	ENSYS		Ohmicron		Quantix/Idetek	
	Water ppb	Soil ppm	Water ppb	Soil ppm	Water ppb	Soil ppm
2,4-D @	0.5	0.2	0.70	--	--	--
2,4-DNT	--	0.5	--	--	--	--
2,4-D Butyric butyl ester	0.02**	1.8	--	--	--	--
Acetanilide	0.1	--	--	--	--	--
Acetochlor	0.1	--	--	--	--	--
Alachlor @	0.1	--	0.05	--	100	--
Alachlor Sulfonic acid	0.1**	--	--	--	--	--
Aldicarb @	1	--	0.25	--	--	--
Aldicarb Sulfone	5	--	0.27	--	--	--
Aldicarb Sulfoxide	10**	--	1.8	--	--	--
Aldrin	0.32**	--	0.29*	--	--	--
Ametryn	0.01**	--	--	--	--	--
Atrazine @	0.01	10**	0.05	--	--	--
Azinphos	10**	--	--	--	--	--
Benomyl @	0.1**	--	0.38	--	50	--
BHC, alpha	--	2	--	--	--	--
BHC, delta	--	2	--	--	--	--
BHC, gamma (lindane)	--	1	20*	--	--	--
Bioresmethrin	100	--	--	--	--	--
Captan @	--	--	0.01	--	--	--
Carbaryl @	--	--	0.25	--	--	--
Carbendazim	--	--	0.10	--	--	--
Carbofuran @	0.1**	--	0.06	--	--	--
Chlordane	10	0.02	--	--	--	--
Chlorpyrifos	0.05	--	0.10	--	--	--
Chlorsulfuron	0.04	--	--	--	--	--
Cholorthalonil		--	0.07	--	500	--
Cyanazine @	0.25	--	0.04	--	--	--
Cyclodienes	5.0	--	--	--	--	--
DDD	--	0.01	--	--	--	--
DDE	--	0.18	--	--	--	--
DDT	--	0.2	--	--	--	--
Diazinon	0.03	--	--	--	--	--
Dicamba	98**	--	--	--	--	--
Dichlorprop	17**	12	--	--	--	--
Dieldrin	0.1	0.006	0.55**	--	--	--
Diquat	30**	--	--	--	--	--
Dursban	0.05	--	--	--	--	--
* Determined in Cyclodiene Ohmicron kit - see vendor literature						
** Lower Level of Detection (LLD) under laboratory conditions						
@ = available as PE samples						
-- = not tested						

Table 2f - Individual Pesticide, Insecticide, and Herbicide Reactivity						
Parameter/Analyte	ENSYS		Ohmicron		Quantix/Idetek	
	Water ppb	Soil ppm	Water ppb	Soil ppm	Water ppb	Soil ppm
Endosulfan	0.08	--	1.2*	--	--	--
Endosulfan I	--	0.006**	--	--	--	--
Endosulfan II	--	0.006**	--	--	--	--
Endrin	0.15**	0.006**	--	--	--	--
Ethylated Atrazines	0.05	--	--	--	--	--
Fenitrothion	100	--	--	--	--	--
Heptachlor	0.69**	0.006**	0.66	--	--	--
Hexazinone	0.1	--	--	--	--	--
Hydroxy atrazine	0.007**	--	--	--	--	--
Imazapyr	0.30	--	--	--	--	--
Imazaquin	5.0	--	--	--	--	--
Isoproturon	0.05	--	--	--	--	--
Metalaxyl	0.1	--	--	--	--	--
Methomyl	--	--	0.45	--	--	--
Methoprene	1000	--	--	--	--	--
Metolachlor	0.1	--	0.05	--	100	--
Metribuzin	--	--	0.04	--	--	--
Metsulfuron	0.25	--	--	--	--	--
Molinate	0.5	--	--	--	--	--
Nicotine (in tobacco)	10	--	--	--	--	--
Paraquat	0.02	--	0.02	--	--	--
Parathion	0.04	--	--	--	--	--
Picloram	1000**	--	--	--	--	--
Pirimiphos-methyl	--	--	--	--	--	--
Procymidone @	--	--	0.80	--	--	--
Prometon	0.008**	--	0.05	--	--	--
Prometryn	0.015**	--	0.05*	--	--	--
Reldan	0.02	--	--	--	--	--
Silvex 2,4,5-TP	0.50	0.05	1.4	--	--	--
Simazene	0.04**	--	0.03	--	--	--
Thiabendazole	0.25	--	--	--	--	--
Toxaphene	3.8	0.005**	2.6**	--	--	--
Triasulfuron	0.05	--	--	--	--	--
Triazine	0.1	--	--	--	50	--
Trichloropyridinol	--	--	0.25	--	--	--
Trichopyr	--	--	0.03	--	--	--
Trifluralin	--	--	--	--	1.0	--
Urea Herbicides	0.05	--	--	--	--	--
* Determined in Cyclodiene Ohmicron kit - see vendor literature						
** Lower Level of Detection (LLD) under laboratory conditions						
@ = available as PE samples						
-- = not tested						

Table 3a - TPH / BTEX Cross-Reactivity

Parameter /Analyte	D-Tech		ENSYs		Ohmicron		Quantix/Idetek	
	Water ppm*	Soil ppm	Water ppm*	Soil ppm*	Water ppm	Soil ppm	Water ppm	Soil ppm
Acenaphthene			0.01	0.5	0.17	1.7		
Anthracene					0.06	0.6		
Benzo(a)pyrene	6							
Benzoic acid	>500							
Biphenyl				10				31
Chrysene	6							
Creosote				1.5	0.10	1.0		1.0
1,2-Dichlorobenzene	5		0.02	2.5				
2,4-Dinitrotoluene	>500							
n-Decane					14	140		
2-Ethyltoluene	5							
4-Ethyltoluene	5							
n-Heptane			1.6	130	2.4	24		
Hexachlorobenzene			0.1	10	0.08	0.8		
Hexane (mixed)				65				
n-Hexane	>500				6.3	63		
Isooctane	72		0.11	8.5				
MTBE			>1200	>1000				
Methylcyclohexane	>500							
2-Methylpentane			0.45	35				
Naphthalene	11		0.008	0.8	0.03	0.3	0.08	2.2
Nitrobenzene	5							
2-Nitrophenol	>500							
n-Nonane					4.4	44		
n-Octane					3.4	34		
o-Cresol	5							
16 PAHs	>500							
Pentachlorophenol	>500							
Phenanthrene					0.08	0.8		
n-Propylbenzene					0.27	2.7		
Styrene			0.07	7.0	0.07	0.7		
1,2,4-Trimethylbenzene					0.04	0.4		
1,3,5-Trimethylbenzene					0.14	1.4		
Undecane			>12	>1000				

\* lowest concentration that yields a positive test result.

Table 3b - PAH and C-PAH Cross-Reactivity

Parameter/Analyte	D-Tech		ENSYS		Ohmicron		Ohmicron		Quantix/Idetek	
	Water ppm	Soil ppm	Water ppm	Soil ppm	Water ppb	Soil ppm	Water ppb	Soil ppm	Water ppm	Soil ppm
Creosote				5.4	1.5	0.11	1.2	0.12	0.1	1.0
Fuel oil #1					[280]					
Fuel oil #2									4	30
Fuel oil #4					[16]			2.1		
Fuel oil #6					[5.0]	0.5	6.6	1.1	6	63
Heating fuel					17	1.3	20	3.2		
Diesel fuel					36	2.0	240	18	1	8
Turbine fuel					[20]					8
Fuel oil # 5					17		0.3	1.3		
JP-4					[610]				2	16
JP-5					[340]				10	100
Jet A Fuel					>10,000	>1000	>10,000	>1000		
Gasoline					13	100	200	160	4	40
Kerosene					1700	120	2800	830	6	60
BTEX	>100								3	32
Benzene				>200						>500
Phenol				>200						
Toluene				>200						>500
2,4,6-Trichlorobenzene				>20						
2,3,5,6-Tetrachloro- benzene				>200						
Pentachlorobenzene				>200						
Pentachlorophenol	>200			>200						
BEHP				>200						
1-methyl-Naphthalene				54						0.6
2-methyl-Naphthalene				58						1.9
1-Chloro-Naphthalene				59						
Halowax 1051				18						
Dibenzofuran				14						
Aroclor 1254	>100									
Biphenyl										31

[ ] = LLD x 50% B/B<sub>0</sub>



Table 3c - PCB Cross-Reactivity

Parameter/Analyte	D-Tech			ENSYS		Ohmicron	
	Wipe *		Soil	Water	Soil	Water	Soil
	Surf A	Surf B	ppm	ppm	ppm	ppb	ppm
Biphenyl						>10,000	
Bifenox	450	220	25		1000		
Halowax 1000	18,000	9000	1000				
Halowax 1051					1000		
Halowax 1099	4500	2200	250				
2,5-Dichlorophenol						>10,000	
2,3,5-Trichlorophenol						>10,000	
Di-n-octylphthalate						>10,000	
Tetradifon					100		
2,4-Dichloro-1-naphthol					50		
See fact sheets for others							

\* wipe concentration = ug/100cm<sup>2</sup>

Surface A is used to interpret test results from non-porous surfaces, smooth metal or glazed tile-like surfaces.

Surface B is used to interpret test results from painted surfaces, rusted metals, or concrete-like surfaces.

Table 3d - TNT/RDX Explosives Cross-Reactivity

Parameter/Analyte	D-Tech		ENSYS		Ohmicron	
	Water ppb	Soil ppm	Water ppb	Soil ppm	Water ppb	Soil ppm
<b>TNT</b>						
2-Amino-4,6-dinitrotoluene	>500	>50				
4-Amino-2,6-dinitrotoluene	>500	>50		>100	0.10	5.9
2,6-Diaminonitrotoluene	>500	>50				
2,4-Dinitroaniline					0.10	0.99
1,2-Dinitrobenzene					1000	3300
1,3- Dinitrobenzene					2.4	11
2,4-Dinitrophenol	>500	>50			8.0	240
2,4-Dinitrotoluene	120	12		1.1	1.0	3.3
2,6-Dinitrotoluene	>500	>50		2	100	360
HMX (3)	>500	>50				
Picric Acid					0.25	4.5
Nitrobenzene				>100	3400	>10,000
2-Nitrophenol				>100	2300	>10,000
2-Nitrotoluene	30	3.0			0.25	2.4
3-Nitrotoluene				>100	160	1400
4-Nitrophenol	>500	>50				
4-Nitrotoluene				>100	1200	5600
RDX (2)	>500	>50			700	2900
Tetryl (1)	15	1.5		0.9	0.10	1.9
1,3,5-Trinitrobenzene	20	2.0		1.0	0.04	0.15
<b>RDX</b>						
HMX (3)	150	15		2.4		
Nitroglycerine				8.9		
Nitroguanadine				10		
PETN (4)	>500	>50		1.0		
Tetryl (1)	>500	>50				
TNT (5)	>500	>50				
All others listed above	>500	>50				

- (1) Tetryl = Methyl-2,4,6-trinitrophenylnitramine  
 (2) RDX = Hexahydro-1,3,5-trinitro-1,3,5-triazine  
 (3) HMX = Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine  
 (4) PETN = Pentaerythritol tetranitrate  
 (5) TNT = Trinitrotoluene

Table 3e - Individual Analyte Cross-Reactivity

Parameter/Analyte	D-Tech		ENSYS		Ohmicron		BioNebraska	
	Water ppb	Soil ppm	Water ppb	Soil ppm	Water ppb	Soil ppm	Water ppm	Soil ppm
Mercury Test								
Gold trichloride							300	
Chromium nitrate							240	
Silver nitrate							17	
Pentachlorophenol	*	*						
CCA (1)			>10,000	>1000				
4-Chlorophenol			>800	>1000				
Creosote			>1000	>1000				
2,3-Dichlorophenol					610	>1000		
2,4-Dichlorophenol			>1000	>1000	880	>1000		
2,5-Dichlorophenol					63	210		
2,6-Dichlorophenol			600	700	270	420		
3,5-Dichlorophenol					1700	>1000		
Diesel fuel			>10,000	>10,000				
Hexachlorobenzene					1600	>1000		
Hexachlorocyclohexane					5800	>1000		
PCB (Aroclor 1254)			>1000	>1000				
Pentachlorobenzene			>1400	>1000				
Phenol			>600	>1000				
2,3,4-Trichlorophenol			600	400	53	120		
2,3,5-Trichlorophenol					1.5	3.7		
2,3,6-Trichlorophenol					2.4	4.4		
2,4,5-Trichlorophenol			500	100	22	38		
2,4,6-Trichlorophenol			100	16	15	22		
Tetrachlorohydroquinone			>1500	500	8.7	14		
2,3,4,6-Tetrachlorophenol					0.91	1.2		
2,3,5,6-Tetrachlorophenol			7	1.2	0.21	0.39		
TCE/PCE	*	*						
Dioxin (2,3,7,8-TCDD)			#	#				

\* Contact D-Tech, literature unavailable at time of publication

(1) CCA = Chromated copper arsenate

# 2,3,7,8-TCDF only analyte to show cross reactivity (approx. 20 times less sensitive than 2,3,7,8-TCDD)

Table 4 - Assay Kit Storage and Operating Conditions

Parameter/Analyte	D-Tech		ENSY5		Ohmicron		Quantix/Idetek		BioNebraska	
	Water	Soil	Water	Soil	Water	Soil	Water	Soil	Water	Soil
Storage Temp.										
PCP			40°F (4°C)	Room temp	36-46°F (2-8°C)					
PCB	40-100°F (4-38°C)		Room temp.		36-46°F (2-8°C)					
PAH	40-100°F (4-38°C)		< 80°F (27°C)		36-46°F (2-8°C)			refrigerate		
BTEX/TPH	40-100°F (4-38°C)		Room temp.		36-46°F (2-8°C)		refrigerate	refrigerate		
TNT/RDX	refrigerate		Room temp.		36-46°F (2-8°C)					
Pesticides			Room temp.		36-46°F (2-8°C)					
Benzene			Room temp.							
Dioxin			Room temp.							
Mercury			Room temp.						40°F (4°C) **	
TCE/PCE	40-100°F (4-38°C)									
THMs			Room temp.							
Operating Temp.					*	*				
PCP			55-90°F (13-32°C)		59-86°F (15-30°C)					
PCB	45-100°F (7-38°C)		40-90°F (4-32°C)		59-86°F (15-30°C)					
PAH	45-100°F (7-38°C)		48-90°F (9-32°C)		59-86°F (15-30°C)			50-85°F		
BTEX/TPH	45-100°F (7-38°C)		60-100°F (16-38°C)		59-86°F (15-30°C)		50-85°F	50-85°F		
TNT/RDX	Room temp.		40-100°F (4-38°C)		59-86°F (15-30°C)					
Pesticides			64-81°F (18-27°C)		59-86°F (15-30°C)					
Benzene			55-90°F (13-32°C)							
Mercury			50-98°F (10-37°C)						50-98°F (10-37°C)	
TCE/PCE	45-100°F (7-38°C)									
Dioxin				Room temp.						
THMs			Room temp.							
Shelf Life										
PCP			3 mo. room/4 mo. refrig		1 Year					
PCB	expiration date		6 mo. <80°F (27°C)		1 Year					
PAH	expiration date		6 mo. <80°F (27°C)		1 Year			6 mo.		
BTEX/TPH	expiration date		12 mo.		1 Year		6 mo.	6 mo.		
TNT/RDX	expiration date		24 mo. <80°F (27°C)		1 Year					
Pesticides			6 mo. <80°F (27°C)		1 Year					
Benzene			6 mo. <80°F (27°C)							
Dioxin			6 mo. <80°F (27°C)							
Mercury			6 mo. 40°F (4°C)						6 mo. 40°F (4°C)	
TCE/PCE										
THMs			6 mo. <80°F (27°C)							

\*All Kits are validated for 4°-37°C (39°-100°F)

\*\* Mercury test kits stored at 4°C; extracts can be stored at room temp.

Table 5 - Moisture Removal Guidelines						
Parameter/Analyte	ENSYS		Ohmicron		BioNebraska	
	Water	Soil	Water	Soil	Water	Soil
All parameters	Place sample on an absorbant material, (filter paper or coffee filter) and ring out. Reweigh sample.  pH should be between 3-11. See Vendor's literature for special cases.		Measure sample into a coffee filter. Wrap filter with paper towels and squeeze out water. Remove the soil and weigh.  pH should be between 3-11. See Vendor's literature for special cases.		No need to remove water, but more sample will be needed with high moisture samples.  Highly alkaline soils may need more acid to digest sample.	

Table 6a - Kit Process Times (Samples per batch / Batch process time)

Parameter/Analyte	D-Tech		ENSYS		Ohmicron		Quantix/Idetek		BioNebraska	
	Water	Soil	Water	Soil	Water	Soil	Water	Soil	Water	Soil
Total BTEX					50/60m	20/120m	3/30m	5/30m		
TPH			10/50m	10/70m	50/60m	20/120m	5/15m	5/30m		
C-PAHs					50/60m	20/120m				
PAHs		4/25m	10/70m	10/70m	50/60m	20/120m	5/30m	5/30m		
PCB		4/25m		10/75m	50/60m	20/120m				
PCB wipe		4/25m								
PCB oil				4/45m						
Pentachlorophenol				10/70m	50/60m	20/120m				
TNT		4/25m		10/40m	50/60m	20/120m				
RDX		4/25m		10/40m						
Mercury				16/90m						16/90m
Dioxin (2,3,7,8-TCDD)			5/70m							
THMs										
TCE/PCE	4/25m									
Pesticides			44/90m P	12/30m	60/60m	60/120m				
Benzene			5/60m							

m = minutes  
P = Plate kit

Table 6b - Cost per Sample

Parameter/Analyte	D-Tech		ENSYS		Ohmicron		Quantix/Idetek		BioNebrask	
	Water	Soil	Water	Soil	Water	Soil	Water	Soil	Water	Soil
Total BTEX		\$26	\$25	\$25	\$7 / \$11	\$13 / \$20	\$32	\$32		
TPH			\$25	\$25			\$32	\$32		
C-PAHs					\$15 / \$19	\$20 / \$27				
PAHs		\$26	\$40	\$40	\$13 / \$18	\$19 / \$25	\$36	\$36		
PCB		\$31	\$30	\$30	\$13 / \$18	\$19 / \$25				
PCB Wipe		\$31		\$30						
PCB Oil				\$25						
Pentachlorophenol	\$26	\$26	\$40	\$40	\$8 / \$11	\$14 / \$15				
TNT	\$26	\$26		\$21	\$7 / \$11	\$13 / \$20				
RDX	\$26	\$26		\$25						
Mercury										\$21
Dioxin (2,3,7,8-TCDD)				\$50						
THM's				\$15						
TCE/PCE		\$26								
Extraction Kits		\$25								
Comments:	Kits usually contain materials for 4 tests.  Meter \$299.00  Computer program \$ 150.00		Sold as 12 tests per kit, with 1, 2 or more calibrators.		Water kits sold in 100 or 30 tube kits. With standards and blanks, the 30 tube kit equates to 22 samples per kit.  Soil kits sold in 80 or 20 samples/ kit. Includes sample collection and extraction kits.  Prices: Large kit / Small kit		Kit includes soil collector, sample preparation supplies, and extraction tubes. Meter not included.		May be purchased as the total kit, or just the assay kits, or extraction kits.	

Table 6c - Individual Pesticide, Insecticide, and Herbicide Cost per Sample						
Parameter/Analyte	ENSYS		Ohmicron		Quantix/Idetek	
	Water	Soil	Water	Soil	Water	Soil
2,4-D	\$8	\$8	\$12			
Alachlor	\$8		\$10		\$8	
Aldicarb	\$8		\$10			
Atrazine			\$10		\$8	
Benomyl	\$9		\$12		\$10	
Bioresmethrin	\$8					
Captan			\$12			
Carbaryl			\$11			
Carbofuran	\$8		\$10			
Chlordane		\$8				
Chlorpyrifos	\$8		\$13			
Chlorosulfuron	\$8					
Chlorothalonil			\$11		\$10	
Cyanazine	\$9		\$11			
Cyclodienes	\$8		\$12			
DDT		\$8				
Diazinon	\$9					
Fenitrothion	\$14					
Isoproturon	\$8					
Imazaquin					\$10	
Imazapyr	\$9					
Lindane		\$14				
Metsulfuron	\$8					
Metalaxyl	\$9					
Methomyl			\$13			
Methoprene	\$9					
Metolachlor	\$14		\$10		\$8	
Metribuzin			\$13			



Table 6c - Individual Pesticide, Insecticide, and Herbicide Cost per Sample						
Parameter/Analyte	ENSYS		Ohmicron		Quantix/Idetek	
	Water	Soil	Water	Soil	Water	Soil
Nicotine (in tobacco)	\$9					
Paraquat	\$9		\$12			
Procymidone	\$8					
Silvex			\$13			
Toxaphene		\$8				
Triasulfuron	\$7					
Triazine	\$8					
Trichloropyridinol			\$16			
Triclopyr			\$13			
Trifluralin					\$8	
Urea Herbicides	\$8					
Comments:	<p>Tube kits consist of 40 tubes, which equates to 24 field samples analyzed.</p> <p>Plate kits contain 96 test wells per kit, which equates to 44 fields samples analyzed.</p>		<p>Available in 30 and 100 tube kits.</p> <p>Prices based on average of 20 field samples analyzed in a 30 tube kit (remainder needed for standards).</p>		<p>48 assays per kit. Microwell kits used.</p>	